

REMARKS/ARGUMENTS

Claims 9-13 are pending in this application. By this Amendment, Applicant cancels Claims 1-8 and adds new Claims 9-13.

Claim 10 corresponds to withdrawn Claim 3. Accordingly, Applicant considers that Claim 10 to be withdrawn from further consideration as being directed to a non-elected species. Since Claim 10 is dependent upon generic Claim 9, Applicant respectfully requests that the Examiner rejoin and allow claim 10 when Claim 9 is allowed.

Claims 4 and 8 were rejected under 35 U.S.C. § 112, second paragraph, for allegedly being indefinite. Claims 4 and 8 have been canceled. New Claims 11 and 13 recite features that are similar to the features recited in canceled Claims 4 and 8, but which have been drafted to correct the informalities contained in canceled Claims 4 and 8. Accordingly, Applicant respectfully submits that new Claims 11 and 13 are clear and definite.

Claims 1, 2, 4-6, and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jewell (U.S. 5,617,445). Claims 1, 2, 4-6, and 8 have been canceled. Accordingly, Applicant respectfully submits that the rejection of Claims 1, 2, 4-6, and 8 over Jewell is moot.

New Claim 9 recites:

**A two-dimensional photonic crystal surface-emitting laser**  
comprising:

a photonic crystal which has a photonic crystal periodic structure located in or near an active layer which emits light when carriers are injected thereto, said photonic crystal periodic structure including a base medium and at least one medium defining lattice points, the base medium and the at least one medium having different refractive indices in a two-dimensional periodic array; wherein

**said photonic crystal period structure is a substantially square lattice structure or a substantially rectangular lattice structure; and**

**said photonic crystal period structure is classified into pg by a classification method under IUC (International Union Crystallography in 1952). (emphasis added)**

New Claim 12 recites:

**A two-dimensional photonic crystal surface-emitting laser**  
comprising:  
a photonic crystal which has a photonic crystal periodic structure located in or near an active layer which emits light when carriers are injected thereto, said photonic crystal periodic structure including a base medium and at least one medium defining lattice points, the base medium and the at least one medium having different refractive indices in a two-dimensional periodic array; wherein  
**said photonic crystal period structure is a substantially square lattice structure or a substantially rectangular lattice structure;**  
the lattice points are substantially triangular lattice points; and  
**said photonic crystal period structure is classified into pm, cm, or pl by a classification method under IUC (International Union Crystallography in 1952).** (emphasis added)

Applicant's Claim 12 recites features that are similar to the features recited in Applicant's Claim 9, including the above-emphasized feature.

With the unique combination and arrangement of features, including the feature of "said photonic crystal period structure is classified into pg by a classification method under IUC (International Union Crystallography in 1952)" as recited in Applicant's Claim 9 and the feature of "said photonic crystal period structure is classified into pm, cm, or pl by a classification method under IUC" as recited in Applicant's Claim 12, Applicant has been able to provide a two-dimensional photonic crystal surface-emitting laser which emits single-lobe linearly polarized light and which has a high Q-value (see, for example, the first full paragraph on page 8 of the originally filed specification).

The Examiner alleged that Jewell teaches "a two-dimensional photonic crystal surface-emitting laser comprising a photonic crystal which has a photonic crystal periodic structure (column 3, lines 30-35; column 2, lines 30-50; and column 7, lines 40-45) located in or near an active layer (FIG. 1A, 18; FIG. 4, 18) which emits light when carriers are injected thereto, said photonic crystal periodic structure having media with different refractive indices (see column 7, lines 40-60; especially, 'refractive index of the

**composite** medium' and its definition; hence, '**different** refractive indices; and 'in or **near** active layer') in two-dimensional periodic array (FIG. 2K), wherein said photonic crystal periodic structure has translation symmetry but does not have rotation symmetry (FIG. 2K has translation but not rotation symmetry)."

The Examiner acknowledged that Jewell does not explicitly illustrate in Fig. 2K and describe in the related text that the photonic crystal periodic structure is a square lattice structure or a rectangular lattice structure. However, the Examiner alleged that Fig. 2C of Jewell shows a square lattice structure. Thus, the Examiner concluded that it would have been obvious to modify the lattice structure shown in Fig. 2K of Jewell so as to be a square lattice structure as shown in Fig. 2C of Jewell.

The Examiner further alleged, "Jewell discloses in Fig. 2C and related text said photonic crystal periodic structure is of a square lattice structure (84) or a rectangular lattice structure which is classified into pl, pm, pg or cm by a classification method under IUC (International Union of Crystallography in 1952) (inherently a 'pl, pm, pg or cm' lattice structure by Applicant's admission; on pages 17 & 18 of the specification Applicant admits that the lattice structure of the type described by Jewell in Fig. 2C is a pl, pm, pg or cm lattice structure)."

Applicant respectfully disagrees with the Examiner's allegations.

First, Jewell is directed to a completely different type of laser than the laser recited in Applicant's Claims 9 and 12. Jewell is directed to quantum cavity light emitters (QCLEs) which are arranged in a two-dimensional array. The QCLEs of Jewell are light emitting devices that are operable independently of one another. Each of the QCLEs of Jewell is provided with a resonator in the cavity thereof so as to resonate in modes shown in Figs. 3A to 3E of Jewell, and light is emitted from the cavity in each of the QCLEs.

In contrast, the laser recited in Applicant's Claims 9 and 12 is a two-dimensional crystal surface-emitting laser in which a plurality of lattice points define a plane resonator, and a component of light is diffracted in a direction perpendicular to the plane

of the resonator, such that the light traveling in the photonic crystal in the direction perpendicular to the plane is diffracted and expelled from the photonic crystal.

Thus, contrary to the Examiner's allegations, Jewell teaches a plurality of separately operable QCLEs arranged various arrangements, and clearly fails to teach or suggest a "two-dimensional photonic crystal surface-emitting laser" as recited in Applicant's Claims 9 and 12.

Second, Jewell neither teaches nor suggests that the square lattice structure shown in Fig. 2C could or should be utilized with lattice points having any shape other than the square lattice points shown in Fig. 2C, and certainly fails to teach or suggest that the lattice structure shown in Fig. 2C is suitable for use with the lattice points shown in Fig. 2K. Thus, the Examiner's allegation that it would have been obvious to modify the lattice structure shown in Fig. 2K of Jewell so as to be a square lattice structure as shown in Fig. 2C of Jewell is completely unsupported by any evidence whatsoever.

As clearly shown in Figs. 2A-2K Jewell, the only square or rectangular lattice structure shown or disclosed in Jewell is for square and rectangular lattice points. None of the other shaped lattice points are shown or disclosed as being suitable for a square or rectangular lattice structure. Thus, contrary to the Examiner's allegations, it clearly would not have been obvious to modify the lattice structure shown in Fig. 2K of Jewell so as to be a square lattice structure as shown in Fig. 2C of Jewell.

Third, Jewell fails to teach or suggest anything at all about the classifications of the photonic crystal period structure, and certainly fails to teach or suggest the feature of "said photonic crystal period structure is classified into pm, cm, or pl by a classification method under IUC (International Union Crystallography in 1952)."

Contrary to the Examiner's allegation, Applicant does not admit that the lattice structure of the type described by Jewell in Fig. 2C is a pl, pm, pg or cm lattice structure. Pages 17 and 18 of the Applicant's specification, which the Examiner referred to in the Office Action, disclose, "It is generally known that two-dimensional periodical patterns are classified into 17 kinds under IUC (International Union of

Crystallography in 1952). Those which do not have rotational symmetry are pl, pm, pg and cm.”

The lattice structure of the type described by Jewell in Fig. 2C clearly has rotational symmetry. Thus, the lattice structure shown in Fig. 2C of Jewell would clearly not be classified as any of pl, pm, pg, or cm, since these classifications do not have rotational symmetry. Thus, Jewell certainly fails to teach or suggest the feature of “said photonic crystal period structure is classified into pg by a classification method under IUC (International Union Crystallography in 1952)” as recited in Applicant’s Claim 9 and the feature of “said photonic crystal period structure is classified into pm, cm, or pl by a classification method under IUC (International Union Crystallography in 1952)” as recited in Applicant’s Claim 12.

Accordingly, Applicant respectfully submits that Jewell clearly fails to teach or suggest the unique combination and arrangement of features recited in Applicant’s Claim 9 and 12.

In view of the foregoing amendments and remarks, Applicant respectfully submits that Claims 9 and 12 allowable. Claims 10-12 and 13 depend upon Claims 9 and 12, and are therefore allowable for at least the reasons that Claims 9 and 12 are allowable.

In view of the foregoing amendments and remarks, Applicant respectfully submits that this application is in condition for allowance. Favorable consideration and prompt all

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The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

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/Christopher A. Bennett, #46,710/  
Attorneys for Applicant

**KEATING & BENNETT, LLP**  
1800 Alexander Bell Drive, Suite 200  
Reston, VA 20191  
Telephone: (571) 313-7440  
Facsimile: (571) 313-7421

Joseph R. Keating  
Registration No. 37,368  
  
Christopher A. Bennett  
Registration No. 46,710